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EDITORIAL.

Breeding and Feeding of Pigs.

The pig-breeding policy adopted at the Government Stock Farm at Serdang has been directed to the maintenance of a stock of English Middle White and Large Black breeds for the supply of stud animals to cross with the local Chinese pigs. At an early stage of the investigations it was observed that Chinese sows crossed with boars of either of these two breeds result in a progeny greatly superior to the Chinese sows. The litters have all the characteristics of the sire; in particular, the hollow back and flat pasterns of the sow are replaced by the straight back and well-developed pasterns of the boar. These improved characters result in an increase in the percentage of carcase to live-weight and an increase in the proportion of the more valuable parts of the carcase.

Chinese pig-breeders were not slow to appreciate the advantage of these cross-breeds as is shewn by the fact that over 200 stud animals have been distributed from the small Serdang stock during the past five years in addition to sale of stud animals from the smaller Agricultural Stations.

While the Chinese methods of pig feeding satisfied the owners by producing a marketable animal at from 8 to 10 months old, such methods were inadequate to satisfy the appetites of the cross-breeds as they reached maturity at an earlier date than the Chinese pig. Investigations have therefore been directed to a consideration of the concentrated rations suitable for cross-bred pigs, the economics of the question being kept in mind. The results of this investigation form the basis of an article by Messrs. T. D. Marsh and N. Kanagaratnam which is published in this number. Two alternative rations, consisting of foodstuffs easily procurable in Malaya, are given which have been found suitable and economical and which will rear the cross-bred pigs to one picul (133 lbs.) weight in $5\frac{1}{2}$ to 6 months.

The more general adoption of improved breeds of pigs coupled with improved feeding is highly desirable and would go far towards making Malaya self-supporting in her requirements of pigs. There are over 700,000 pigs in Malaya, and the annual import of swine to supplement local production is about 150,000. The value of imports usually exceeds 2 million dollars, a sum that we expect to see gradually reduced as breeders improve their stock and their methods of feeding.

Composting. The problem of obtaining a satisfactory organic manure for market gardens and for horticultural purposes has engaged the attention of the Department of Agriculture for some years. Owing to the unimportance of dairy husbandry in Malaya, it is generally difficult to obtain adequate supplies of cattle manure for use in agriculture. Artificial manures are not a complete substitute for organic manures, for the latter stimulate soil bacteria and also improve the physical properties of the soil.

Early investigations on this subject were coupled with the desirability of discovering an economic method of disposal of the large quantities of waste from pineapple factories. In the article on Organic Composts which will be found in this number Mr. J. H. Dennett shews that he has not lost sight of this particular aspect of the question.

The major part of the article, however, is concerned with the adaptation to local conditions of a method of preparation of an organic manure similar to that which has proved successful in India. A marked measure of success has been obtained and to those whose interest centres in horticulure as well as to market gardeners is offered a means of obtaining adequate supplies of organic manure throughout the year.

Further investigations are in hand on this subject. Comparisons are to be made of making the compost in the open and under cover and with and without the addition of cattle manure and artificials. These further experiments will concern the economics of compost production; they are unlikely to affect the recommendations contained in the present article, but will supplement the information and possibly widen the practical application of this method of obtaining an effective substitute for cattle manure.

Original Articles.

PIG HUSBANDRY AND PRELIMINARY FEEDING TRIALS AT THE STOCK FARM, SERDANG

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Introductory.

Pig husbandry has been practised at the Government Stock Farm, Serdang, for some years. The policy until recently was the establishment and maintenance of small herds of the English Middle White and Large Black breeds for the supply of stud animals for crossing with the local Chinese pigs.

Trials were made at Serdang in crossing boars of these breeds with sows of two types of Chinese pigs purchased locally. It was considered that cross-breeding experiments should be carried out at Serdang to obtain first-hand observations on the results and to supply a small demand for selected half-bred boars. It was appreciated that the Chinese breed had in the past been used fairly extensively in the establishment of many of the Western breeds, so that such cross-breeding is the mating of pigs not distantly related.

These cross-breeding trials, using the common piebald and black Chinese breeds, were in every way a success, whilst the prolificacy and good milking qualities of the Chinese breed were imparted to the offspring. The early maturing qualities of the English breed, their docility and better conformation were transmitted, so that cross-breds had a straighter back and more upright pasterns, with a larger percentage of the weight in the hind-quarters where the carcase is most valuable. In addition, the head was smaller and the percentage of carcase to live-weight higher.

The Chinese breeders were not slow to realize that it was to their advantage to cross-breed, and as soon as it was known that English breed stud pigs were available, the demand for boars and sows became steady and continuous. A total of 226 stud animals has been distributed from Serdang Stock Farm during the years 1932-1937, which has resulted in a regular increase in the percentage of cross-bred animals produced and observed to pass through the Kuala Lumpur abattoirs during each succeeding year and, to a lesser extent, through other abattoirs.

The work at Serdang has been extended to several Departmental Agricultural Stations, where small piggeries have been maintained for demonstration purposes and for the distribution of stud stock at reasonable prices to local pig-breeders.

The Department of Agriculture does not claim the whole of the credit for the improvement during recent years in the type of pig being produced in Malaya. Several European breeders have maintained piggeries and have distributed a number of animals carrying the strains of European breeds in varying proportions, and by their example of the crossing of boars of English breeds with Chinese sows they have been regular propagandists of Departmental policy.

The practice at Serdang has been to distribute only selected animals for stud purposes, the remainder being fattened for the local market. It is known, however, that sows have been selected by Chinese breeders from consignments sold for slaughter and retained for breeding purposes.

Rations have been based on research work carried out in temperate climates, and the knowledge of feeding can only be described as empirical when applied in the tropics; the live-weight increases correlated with time have compared unfavourably with the averages of temperate climates.

It is thought that the hot tropical climate causes a faster rate of respiration than is normal with these breeds in temperate climates and also reduces the appetite.

As the ordinary pig foods of temperate climates, such as barley meal, middlings and dairy by-products on which research in pig-feeding has been based are not available, rations must of necessity be composed of tropical concentrates. Although the rations have been calculated to the recognized feeding standards, no comparative results on actual feeding trials are available on which to base the feeding of pigs.

It is appreciated that the quality of the particular proteins and amino acids in foods plays a fundamental part in their suitability or otherwise for the particular class of feeding for which they are used.

Observations by the Veterinary Department at the Kuala Lumpur abattoirs indicate that tropical internal parasites show a far higher incidence of infestation in pure-bred European pigs and the cross-bred European—Chinese types than occurs in pure-bred Chinese pigs. Pure Chinese pigs are usually maintained on slatted floors on which reinfestation by the parasites is probably less liable to occur than when pigs are kept on concrete floors and in limited open yards, as usually practised by the larger progressive breeder, Chinese or European.

Loss of vigour, and consequently reduced growth-rate, may result from the breeding of temperate climate pigs in the tropics for several generations, and the periodic introduction of new blood at Serdang has been insufficient to maintain vitality.

Weaner pigs of pure European breeds at the age of 10 weeks average only about 25 lbs. in weight against an average figure in Europe of 30 to 35 lbs. Owing to the absence of dairy by-products, weaners are kept on the sows until they are 10 weeks old to give them a better start in life.

The milking capabilities of the sows have undoubtedly a fundamental influence on the weight of weaner-pigs and it is likely that the tropical climate depresses the milking qualities of sows of European breeds. On the other hand, the imported pigs at Serdang may be from strains which are not particularly good milkers.

This characteristic is most important when selecting gilts for breeding purposes and it is the usual custom amongst pig-breeders to cull from their herds any young sows that cannot feed their first litter *ad libitum*. This principle has been adopted at Serdang with the Large Black breed, but it has been difficult to apply to the Middle White breed owing to losses and the small number of animals in the herd.

When it is appreciated that a well-suckled litter may be 200 to 300 lbs. live-weight and possibly heavier than the mother at 8 to 9 weeks of age, and that 75 per cent. of this live-weight gain is derived from the mother's milk, it will be realized that sows must be remarkably heavy milkers.

The young pigs between the ages of 10 and 20 weeks have been observed to make poor increases in weight. It appears that at this period they are unable to make full use of the proteins usually supplied in their rations and the lack of dairy by-products is most noticeable.

It is a question whether the minerals supplied in milk have not also a fundamental bearing on their well-being and that added raw materials will not adequately replace those obtained from food-stuffs.

Until recent years the Chinese method of feeding pigs was to use those foods that were the cheapest to buy. Early maturity was of little importance, and provided the animals attained weights suitable for slaughtering for the local market at 8 to 10 months of age the owners were satisfied. The cross-breeding that has taken place during recent years has produced animals that require more concentrated rations, and to satisfy their appetite the use of soya bean cake in the rations has been extended. Furthermore, the pure English and cross-bred brood sows have been observed to be, in general, poorer milkers than the pure-bred Chinese sows, and the feeding of soya bean cake to the sows and in the form of a gruel to the litters has become almost universal. This more intense feeding has resulted in earlier maturity and although the rations are more expensive they are fed for a shorter time.

Feeding Trials at Serdang.

An opportunity occurred early in 1937 to commence preliminary trials of feeding weaner pigs. Two Middle White sows farrowed on the 16th and 17th January. Three pens of four pigs in each pen were used for trials; pens of this size are too small for a statistical analysis of the results, but it was thought that the trials might give some indication of the suitability or otherwise of certain foods for the supply of proteins.

The rations were balanced as near as was practicable to Kellner's Standards using the same ingredients, except those forming the principal supply of protein.

Endeavours in the past have been made to purchase dried separated-milk or dried buttermilk, but the prices have always appeared to be too high. Furthermore permits to purchase separated-milk powder are necessary under the Foods Enactment.

Whey powder became available early this year and, whilst not strictly a protein food, it is a dairy by-product containing albulactin, lactose, and milk minerals and its price was fairly reasonable.

The three rations used for the first 10 weeks of the trials were made up as follows:—

Ration A 1. Standard.
Constituent Under Test—Soya Bean Cake.

Food.	Quantity	Digestible Protein.	Fat.	N-free Extract.	Dry Matter.
	lbs.	lbs.	lbs.	lbs.	lbs.
Broken rice ...	26	1.66	.08	20.77	23.03
Rice polishings ...	3	.21	.34	1.22	2.70
Coconut cake (double-pressed) ...	5	.64	.43	2.34	4.41
Soya bean cake ...	11	4.01	.40	2.58	9.22
Guinea grass ...	10	.09	—	.79	2.50
Banana stems ...	20	.02	.02	.07	1.02
Palm oil ...	1	—	1.00	—	1.00
Minerals ...	0.5	—	—	—	.50
TOTALS ...	76.5	6.63	2.27	27.77	44.38

Ration B 1
Constituents Under Test – Whey Powder and Soya Bean Cake.

Food.	Quantity	Digestible Protein.	Fat.	N-free Extract.	Dry Matter.
	lbs.	lbs.	lbs.	lbs.	lbs.
Broken rice ...	16	1.02	.05	12.78	14.18
Rice polishings ...	4	.28	.46	1.63	3.60
Coconut cake (double-pressed) ...	6	.77	.51	2.81	5.29
Soya bean cake ...	8	2.92	.29	1.88	6.70
Guinea grass ...	10	.09	—	.79	2.50
Banana stems ...	20	.02	.02	.07	1.02
Palm oil ...	1	—	1.0	—	1.00
Minerals ...	.25	—	—	—	.25
Whey powder ...	10.00	1.40	.05	7.30	9.80
TOTALS ...	75.25	6.50	2.38	27.26	44.34

Ration C 1
Constituent Under Test—Whale Meat Meal.

Food.	Quantity	Digestible Protein.	Fat.	N-free Extract.	Dry Matter.
	lbs.	lbs.	lbs.	lbs.	lbs.
Broken rice ...	30	1.92	.09	23.97	26.58
Rice polishings ...	2	.14	.23	.81	1.80
Coconut cake (double-pressed) ...	2	.26	.17	.94	1.77
Soya bean cake ...	2	.73	.07	.47	1.68
Guinea grass ...	10	.09	—	.79	2.50
Banana stems ...	20	.02	.02	.07	1.02
Palm oil ...	1	—	1.00	—	1.00
Minerals ...	.25	—	—	—	.25
Whale meat meal ...	8.00	3.87	.80	—	7.50
Totals ...	75.25	7.03	2.38	27.05	44.10

The foregoing rations were made up to Kellner's Feeding Standards for animals averaging 44 lbs. live-weight, which require the following amounts of constituents daily for every 1,000 lbs. live-weight:—

	lbs.
Dry matter	44
Digestible crude protein	6.6
Fat	1
Nitrogen-free extract	28

The rations were constituted to test the effect of one dominant ingredient on live-weight increase. Other foods in the rations were similar, but the proportions were varied so that the rations could be balanced.

Ration A 1 was regarded as standard and the dominant ingredient was soya bean cake.

Ration B 1 supplies a reduced amount of the soya bean cake plus whey powder, which is a dairy by-product containing the important milk minerals and an easily digested food.

Ration C 1 was included to test the value of whale meal as a source of protein; a little soya bean cake was used to balance the ration to Kellner's Standards.

To rations B 1 and C 1 4 ozs., and to ration A 1 8 ozs., of a mineral mixture were added per 1,000 lbs. live-weight of pigs and made up of two parts sterilized steam bone flour, two parts air-slaked lime and one part common salt.

The added minerals were varied in amount, since whale meal contains a fairly high percentage of calcium phosphate and whey powder is rich in reputed easily assimilated minerals.

To all rations 1 lb. of red palm oil per 1,000 lbs. live-weight of pigs was added per day to ensure that adequate amounts of vitamin A were present. The oil content of the rations, however, was in excess of standard requirements for the production of carcases for curing into bacon and ham and such an excess would probably have an adverse influence on the quality of the flesh, but it matters little for the fresh pork trade in this country.

All pigs were dosed with santonin, calomel, and epsom salts before the feeding trials were commenced in an endeavour to expel worms from the alimentary canal.

The pigs were divided into lots of four comprising two boars and two sows and they were selected as near as possible to the same average weights in each of the three pens. The foods were mixed with water in the proportion of three parts of water to one part of meal, and the latter was soaked for twelve hours before feeding. The animals had access to water at all times.

The results of the first trials with Middle White Pigs were as follows:—

	A1 Ration Soya Bean	Ration B1 Soya Bean and Whey Powder	Ration C1 Whale Meat Meal
	lbs.	lbs.	lbs.
Initial average weight at 9 weeks ...	23.25	23.50	23.50
Average weight at 13 weeks. ...	36.25	36.75	32.00
„ „ 17 „ ...	70.37	69.75	55.25
„ „ 19 „ ...	85.75	82.00	64.00
Live-weight gain, total in ten weeks ...	62.50	59.50	40.50
Live-weight gain per day ...	0.89	0.85	0.58
* Meal consumed per 1 lb. live-weight gain Dry ...	2.06	2.50	3.41
Wet ...	3.01	3.68	5.01
Cost of ration per lb. ...	2.82 cts.	4.61 cts.	3.64 cts.
Cost of food per 1 lb. live-weight gain ...	5.80 cts.	11.52 cts.	12.41 cts.
Value of gain per day at current market price, say $20 per picul or 15 cents per lb.	13.35 cts.	12.75 cts.	8.70 cts.

* The actual weights of concentrates were used in the calculation, but weights of both wet and dry succulent foods are taken into account in the above table.

These trials indicate that there is no advantage to be obtained in adding whey powder to a balanced ration containing a fair proportion of soya bean cake with sufficient simple minerals.

Whale meat meal does not provide a protein as suitable for young pigs as that derived from soya bean cake.

The live-weight gain was achieved in the A and B rations with a smaller amount of concentrates than is usual in colder climates, which may suggest that a smaller amount of food is used for the maintenance in the tropics of the bodily temperature, and/or the pigs were able to digest the excess oil fed. Since the animals were satisfied with light rations it would appear, however, that the hot climate impairs their appetite.

These inferences suggest that possibly a slightly higher percentage of protein to nitrogen-free extract and fat may produce better live-weight increases without impairing digestibility of the ration.

Ration A 1 is apparently far more economical than B 1 and C 1 since it is cheaper per lb. and requires a smaller quantity to produce each unit of live-weight increase.

Broken rice, while being an excellent ingredient in the ration of weaner pigs, is considered to be expensive for fatteners, and at four months old, or possibly earlier, it is necessary for economical reasons to replace it with tapioca tubers, sweet potato vines or tubers, or other carbohydrate foods.

When the pigs under test were 19 weeks old the broken rice, banana stems, and Guinea grass were replaced by cooked fresh tapioca tubers, and, utilizing the same ingredients as formerly to make up the rations, they were balanced to suit pigs of 88 lbs. live-weight, which according to Kellner's Standards are as follows:—

	lbs.
Dry matter	36
Digestible crude protein	5
Fat	0.8
Nitrogen-free extract	23

Ration C 2

Constituent Under Test—Whale Meat Meal.

Food.	Quantity.	Digestible Protein.	Fat.	N-free Extract.	Dry Matter.
	lbs.	lbs.	lbs.	lbs.	lbs.
Tapioca roots ...	60	.60	—	18.48	21.00
Rice polishings ...	2	.14	.23	.81	1.80
Coconut cake (double-pressed) ...	3	.39	.26	1.42	2.36
Whale meat meal ...	8	3.87	.80	—	7.50
Palm oil ...	1	—	1.00	—	1.00
Minerals ...	.25	—	—	—	.25
TOTALS ...	74.25	5.00	2.29	20.71	33.91

The results of the second feeding trials were as follows:—

	A2	B2	C2
	lbs.	lbs.	lbs.
Average live-weight on 12th June ...	90.87	93.50	63.00
„ „ 26th „ ...	107.37	105.50	61.00
„ „ 30th „ ...	118.50	112.62	64.62
Live-weight gain 1st to 30th June ...	32.75	30.62	0.62
Live-weight gain per day ...	1.09	1.02	0.02
* Meal consumed per lb. live-weight gain (dry basis tapioca) ...	4.09	3.88	207.66
Cost of ration per lb. ...	2.11 cts.	3.01 cts.	3.15 cts.
Cost of food per 1 lb. live-weight gain ...	8.63 cts.	11.68 cts.	$ 6.54
Value of gain per day at current market price, say $20 per picul or 15 cts. per lb	16.36 cts.	12.01 cts.	0.03 cts.

* The actual weights of concentrates were used in the calculations, but dry weight of tapioca tubers only was used.

The trials were carried on for a further four weeks when the pigs were fed on the following rations:—

Ration A 2
Constituent Under Test—Soya Bean Cake.

Food.	Quantity.	Digestible Protein.	Fat.	N-free Extract.	Dry Matter.
	lbs.	lbs.	lbs.	lbs.	lbs.
Tapioca roots ...	50	.50	—	15.40	17.50
Rice polishings ...	6	.42	.68	2.44	5.40
Coconut cake (double-pressed) ...	6	.77	.51	2.84	5.29
Soya bean cake ...	9	3.29	.32	2.11	7.54
Palm oil ...	1	—	1.00	—	1.00
Minerals ...	.50	—	—	—	.50
TOTALS ...	72.50	4.98	2.51	22.79	37.23

Ration B 2

Constituents Under Test—Whey Powder and Soya Bean Cake.

Food.	Quantity.	Digestible Protein.	Fat.	N-free Extract.	Dry Matter.
	lbs.	lbs.	lbs.	lbs.	lbs.
Tapioca roots ...	40	.40	—	12.32	14.00
Rice polishings ...	6	.42	.68	2.44	5.40
Coconut cake (double-pressed) ...	6	.77	.51	2.84	5.29
Soya bean cake ...	7	2.56	.25	1.85	5.86
Palm oil ...	1	—	1.00	—	1.00
Minerals ...	.50	—	—	—	.50
Whey powder ...	5.	.70	.02	3.65	4.90
TOTALS ...	65.50	4.85	2.46	23.10	36.95

Comments.

Ration A 2, which is the cheapest, gives the greatest and most economical live-weight increases.

No advantage is gained by the addition of whey powder to soya bean cake; the whey powder successfully replaces the soya bean cake but at an enhanced cost. If the smallest pig is excluded from lots A and B the results are very similar, but the soya bean cake fed pigs show a very slight advantage in live-weight gain.

The whale meal is not only incomparable with soya bean cake, but apparently quite unsuitable as the main source of protein in rations for young pigs. It would seem that the ration must be deficient in some important ingredient which is possibly protein or amino acids, and these results are more pronounced when whale meat meal is fed in conjunction with cooked tapioca tubers than when fed with soaked broken rice.

Greater live-weight increases would probably have been obtained if the boars had been castrated.

It is interesting to record that after the boars and sows had been segregated at the conclusion of the trials and all the animals were put on to ration A 2 the pigs that had previously been fed on whale meal each gained an average of 1.10 lbs. per day during the next 14 days compared with a live-weight gain of .02 lbs. per day during the previous month. (see Appendix A).

Summary.

These feeding trials indicate that rations A 1 or A 2, *i.e.* either made up with broken rice for young pigs or tapioca for older animals, although apparently

expensive, are economical and will rear Middle White pigs to a picul (133 1/3 lbs.) weight in 5½ to 6 months.

These trials emphasise forcibly that calculated balanced rations are not necessarily suitable for feeding a particular class of livestock and the only method of proving the value of rations is by feeding trials.

Appendix A.

Records of Individual Weights of Pigs.

Date of farrowing 17th January, 1937.
Date of weaning 21st March, 1937.

	Rice Rations				Tapioca Rations		
	21st March	18th April	16th May	30th May	12th June	26th June	30th June
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Ration A.							
No. 74 gilt ...	25	36	66½	82	89½	97½	110
No. 46 „ ...	27	41	81½	102	114½	127½	142
No. 67 boar ...	22	37	72	87	76	111½	120
No. 93 „ ...	19	31	61½	72	83½	93	102
Ration B.							
No. 72 gilt ...	25	38	69½	78	91½	102½	109
No. 82 „ ...	19	27	48½	60	68½	75½	84½
No. 77 boar ...	30	48	89½	103	116½	130½	135
No. 66 „ ...	20	34	69½	87	97½	113½	122
Ration C.							
No. 63 gilt ...	23	30	52½	64	59½	56½	58½
No. 69 „ ...	22	29	49½	55	56½	56½	59
No. 70 boar ...	24	32	53½	64	63½	61½	67
No. 64 „ ...	25	37	65½	73	72½	69½	74

Animals fed on Ration A from 1st to 15th July 1937; weights on the latter date were as follows:—

No. 63—72½ lbs. No. 69—78 lbs., No. 70—77½ lbs. No. 64—92 lbs.

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ORGANIC COMPOSTS

BY

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Until recent years Malaya has been regarded as a land of great fertility where manures were never required save to produce flowers in the garden. Permanent crop agriculture being almost universal on inland soils, this belief and general attitude is not altogether surprising when it is remembered that land was for the most part opened up from jungle, where conditions of shade and moisture had allowed an accumulation of plant nutrients.

Nowadays, it is the practice rather than the exception to apply fertilizers, in such specific form as may suit, to permanent, as well as to annual crops.(1) The vast majority of fertilizers so applied are in the form of naturally-occurring or artificially prepared mineral material.

Although these artificial fertilizers may have a considerable stimulatory effect on growth or production, there frequently comes a point where such increase cannot be maintained by further applications. As a sequence, consideration has been given to the use of cattle manure, the perennial effect of which, as a fertilizer, has been known since man began to till the soil.

The beneficial effect of cattle manure is due both to its mineral nutrient content directly comparable to artificial fertilizers and to its organic content, the function of which is to stimulate soil bacteria. The obstacle to its use in Malaya is one of supply, owing to the negligible amount of dairy farming or cattle keeping.

In an attempt to find substitutes for cattle manure, enquiries are received from time to time as to the methods of preparation of organic compost. These enquiries are usually concerned with the production of composts for horticultural purposes.

The preparation of composts has been carried out on a large scale for some years at the Institute of Plant Industry, Indore, India, and is now well-known as the Indore Process. Details of the methods and the results obtained were published in 1931 by Howard & Wad under the title of "The Waste Products of Agriculture."(2)*

A number of minor experiments on these lines were carried out locally by Greenstreet (4) and Wilshaw (5) and subsequently published.

A fresh series of experiments was carried out in the laboratory, in which the compost materials, consisting of plant residues readily obtainable locally, were contained in boxes with sloping sides 24 in. x 30 in. at the top, by 20 in. deep. In subsequent experiments the scale was increased by utilizing covered concrete tanks. It was found, however, that these tanks were too shallow and had too great a cooling area.

* This book was reviewed in the *Malayan Agricultural Journal* in 1932. (3)

In view of the frequent and heavy rainfall experienced in Malaya it was considered that to follow the Indore method of open pits would be unsatisfactory and would lead to mosquito breeding, anaerobic conditions and possibly to pest of flies. All work on a large scale, therefore, was conducted with heaps in the open. These heaps were situated within a hundred yards of houses and no complaints were received in regard to flies nor were any flies observed round the heaps throughout the period of preparation.

Raw Materials.

In a country growing chiefly annual crops there is always a large amount of waste material at hand, but in Malaya where the main dry land crops are rubber, coconuts and oil palm, waste is a somewhat difficult matter to obtain in quantity. On oil palm estates there are bunch residues, but, in general, where permanent crops are grown it is necessary to collect the raw material such as green covers, secondary jungle growth or grass.

On or near small holdings, or in market gardens, an adequate supply of green material may be available, while in gardens surrounding houses or schools there is always sufficient grass to form the basis of a good compost heap with the addition of leaves and general plant remains.

There is, however, one industry of some importance to this country where the disposal of waste is a major problem. In the pineapple factories waste was at one time piled in heaps in the hope of its rotting down, and Greenstreet (6) carried out experiments in this connexion with the object of turning these heaps into a compost. He came to the conclusion that owing to the heaps containing 95 per cent. of moisture, a satisfactory product could not be obtained without a preliminary pressing. Latterly, it has been the practice to dump the refuse into the nearest river, but even this is becoming a nuisance and the question of its proper disposal is not completely solved. Further experiments were therefore carried out on the lines of the Indore Process and, as will be shewn, it was found that a satisfactory compost could be obtained in good weather by dealing directly with the wet waste. Unpressed waste will break down to a satisfactory compost and the advantage of pressing is to reduce the bulk of material to be handled.

The Process.

The first outdoor experiments were carried out with mixed grass and leaves in heaps about 8 ft. x 6 ft. by 3 or $3\frac{1}{2}$ ft. deep.* The raw materials were thoroughly withered in the sun to remove practically all internal moisture, as otherwise the material tends to ferment internally (within the cells) rather than break down externally (in the epidermis). About 500 lbs. of dried material were used per heap.

* Any greater depth tends to compress the lower portions and prevent proper aeration when rainfall is heavy.

Following the Indore Process the leaves and grass were wetted with water and thoroughly mixed. The bottom layer was made by spreading this wetted material to a depth of about 4½ inches over an area of 48 square feet. A slurry was then made up of about 5 lbs. fresh cow-dung, ½ lb. wood ash and 3 gallons of water. This was thinly sprinkled over the layer. Small pieces of dung of about half a cubic inch were then scattered over the layer, followed by a sprinkling of cattle urine and a dusting with wood ash. Being unavailable, urinated earth, as recommended by Howard, was not added, neither was any additional earth used, as local soil has an acid pH value between 4.0 and 5.5 and could only react unfavourably on a process which must be kept rather on the alkaline side. Further series of layers were built in a similar manner until the heap was about 3 feet deep when it was covered with a layer of dried grass to protect it from rain.

A second heap was made in a similar manner but with the addition of 3 lbs. calcium cyanamide to see whether an improved product was obtained and whether there was a more rapid decomposition. Similarly 3 lbs. of sulphate of ammonia were added to a third heap, and 6 lbs. of lime to a fourth heap. A fifth heap was built in a somewhat different manner; all the ingredients, leaves, grass, dung, urine, wood ash and water were thoroughly mixed and then made into the heap.

All the heaps were turned on the fifteenth day and a further batch of similar heaps made in the same manner as the first except that they received an inoculation from the original heaps by the incorporation of 5 lbs. of material taken from the centre of the latter and mixed with the slurry.

At the next turn, fifteen days later, the second batch was again inoculated from the first batch, and a third batch was prepared and inoculated from the second batch.

At the end of forty-five days the heaps were again turned, a portion of the first batch being again used to inoculate the second, which was now at the thirty-day stage.

The last turn was made at the end of sixty-days *i.e.* four turns in all, after which the heaps were allowed to mature for another month, when they were considered to be ready for use.

A second series was started in which the 3 lbs. of nitrogenous fertilizers were replaced by phosphates, either 6 lbs. of superphosphate, 6 lbs. of rock phosphate or 6 lbs. of basic slag.

A third series was started in which the basic material consisted of one-third green manure and two-thirds dried grass. The heaps were treated with phosphates or lime in a similar manner to the second series.

It is to be noted that, with the exception of the first batch of the first series, every heap was inoculated at each turn from a heap a fortnight older.

A fourth series was prepared on a somewhat larger scale in which it was attempted to break down oil palm fronds and petioles. These heaps were made 12 ft. x 9 ft. x 3 ft. and consisted of grass and leaves as in the earlier series to which were added approximately 50 per cent. of their weight of petioles and about 20 per cent. of fronds.

The final series consisted of fresh pineapple waste with and without admixture of grass.

Composition of Heaps.

The series is tabulated below:—

Series I (three batches at 14 day intervals)		Series II (three batches at 14 day intervals)
Heap		
1.	Control.	Control.
2.	3 lbs. Calcium cyanamide.	6 lbs. Superphosphate.
3.	3 lbs. Ammonium sulphate.	6 lbs. Rock phosphate.
4.	6 lbs. Lime.	6 lbs. Basic slag.
5.	Materials previously mixed with slurry before making into layers.	6 lbs. Lime.
	Series III.	Series IV.
	As Series II, but Crotalaria and *Tephrosia candida* substituted for leaves.	As Series I control, but old oil palm fronds and petioles incorporated.
	(One batch only)	3000 lbs. grass and leaves.
		1800 lbs. oil palm petioles.
		600 lbs. oil palm fronds.
		Dung and ash in proportion.
Series V — Fresh Pineapple Waste.		
Heap		
1.	1300 lbs. waste, 3000 lbs. dried grass.	
2.	4100 lbs. waste, 1200 lbs. dried grass.	
3.	500 lbs. waste, 100 lbs. dried grass.	
4.	4700 lbs. waste only.	

Temperatures.

Some eight hours after the heaps are first made the temperature begins to rise and, by the end of two days the centre of a well-made heap should be about 125°F., rising by the following day to about 135°F. if the batch has not been inoculated from a previous heap, while if such inoculation has taken place the temperature should be about 10°F. higher. From the fourth day the temperature begins to fall, and by the time of the first turn the centre of the mass should have a temperature of about 100° to 105°F.

Provided there is no rain during the first fifteen days up to the first turn, a considerable amount of evaporation takes place and it is necessary to add water

when turning the heap and inoculating from a thirty-day heap. After this first re-making the temperature rises again during the next three days to about 130°F., gradually falling to between 100° and 105°F. by the end of thirty days. When the heap is again re-made and inoculated from a forty-five day old heap the temperature again rises, but only to about 115°F., and by the end of forty-five days has generally dropped to only a few degrees above atmospheric temperature. After the final turn and inoculation from a sixty-day old heap, there is practically no change in temperature. Although it has not completely lost its original form, the compost may be used at this stage, but the normal procedure, as stated previously, is to keep it for a further month until the material is in the form of a completely disintegrated mould.

Wet Weather.

Although Howard found in India that heaps made in monsoon weather did not differ fundamentally from heaps made in the dry season, locally it was found that heaps of the size described were considerably affected by rain, both as to the rate of decomposition and disintegration and as to the condition of the final product. Continuous rain lowers the temperature of the heaps considerably with a consequent slowing down of the initial stages of decomposition; in addition there is a tendency for the lower layer to become semi-anaerobic with an almost complete fall in temperature to normal. Analysis has shewn that the potash and phosphate contents, and, to a slight degree, the nitrogen content, were reduced by wet weather.

If the compost is to be used for horticultural purposes, the heaps made during the months October—November and March—April, might with advantage be protected by a leaf shelter.

Nitrogen and Phosphates.

The addition of nitrogen or phosphates appears to have little bearing on the rate of decomposition and no great effect on the mineral content of the final product. Lime, however, does appear to hasten the breaking down of the raw material, blackening taking place more rapidly and in addition, the heap, even at the first turn, appears to break up more readily. On the other hand, as is to be expected by the addition of lime, there is a reduction in the nitrogen content. The same effect of more rapid decomposition could probably be obtained by the use of larger quantity of wood ash and, although the nitrogen content would probably be lowered, the product would show an enrichment in phosphate and potash. Unfortunately, ash is not always available in sufficient amounts to enable a larger quantity than that indicated to be used. It is suggested that wood ash should be used as a standard; when unavailable it may be replaced by lime.

In the heaps made with chopped oil palm fronds and petioles it was found that while the fronds broke down fairly easily, even at the end of three months the petioles as a whole were undecomposed. The addition of green manure appeared to have very little effect on the nitrogen content of the final product.

The actual amounts of phosphates and potash present appear to vary according to the rainfall. The 1.2 per cent. of phosphate fertilizer added (varying from 0.2 to 0.4 per cent. of P_2O_5 according to type of fertilizer) does not appear to be reflected in the results.

It would appear better, if it is required to enrich the compost with any mineral fertilizer, to do so immediately before use rather than at the time of composting.

Dung and Urine.

While it is usually possible to obtain a certain quantity of fresh cattle dung for starting the heaps, cattle or horse urine is less easy to obtain.

The great advantage of the addition of urine is that a higher initial temperature is obtained with a consequent hastening of the early stages, but owing to the general difficulty of obtaining it in sufficient amounts for treating every fresh heap it is considered best to disregard it as a usual constituent of the compost heap in Malaya. It is, however, worth adding (when the price is reasonable) to an occasional fresh heap which is to be subsequently used to inoculate other heaps. Fresh dung must be regarded as essential as a rapid "starter" but the quantities used are so small as to have little effect on the final composition.

Laboratory Box Experiments.

In the first laboratory box experiments mentioned above, the layers were made in the box in the same way as in the field but it was found that while the temperature at the centre rose in a normal manner, the small cubic capacity of the boxes entailed a large cooling area, so that only a comparatively small amount of the materials reached the high temperature requisite for decomposition in the early stages. To obviate the difficulty each box was placed in a larger box (28 in. x 34 in. at the top, by 20 in. deep) and the space between the two was tightly packed with hay. This was found to give excellent insulation, and the temperature at the centre at the end of two days reached 160°F.

Although it cannot be recommended for any large-scale work the box method has certain advantages for the small garden, where there are no very large quantities or organic rubbish. It can be readily carried and can be put in a garage or outhouse in wet weather, while turning is easier as the contents of the box can be easily tipped and replaced.

Pineapple Waste.

The pineapple waste series followed much the same course as the others. Dried grass was added in the first heap as a means of absorbing part of the 95 per cent. moisture. Lime was added to neutralize the acidity of the juice rather than as a direct means of hastening decomposition, but in a process which needs a neutral or alkaline medium the neutralization of acid accelerates the rate of decomposition.

The pineapple waste alone, with added lime and slurry, at the end of two months appeared to be in a more advanced state of decomposition and disintegration than composts made of grass and leaves, so that it was considered that the experiment might be tried on a large scale in the field.

By the courtesy of the Malayan Pineapple Company, experiments were laid down at Batu Ampat Estate, Klang, using the pineapple waste from the Klang factory.

The heaps were made 18 ft. x 12 ft. x 4 ft. high and dried pineapple leaves were mixed with the fruit partially to absorb moisture.

About 20 tons of fruit waste were used daily for 23 days, using about 10 tons per heap until an area of approximately an acre was occupied by the heaps. In each heap about 24 lbs. of lime, 12 lbs. of ash, and 150 lbs. of dung were used. The heaps were covered with dried pineapple leaves partially to protect them from rain.

The site was not ideal as the land consisted of shallow consolidated peat overlying a heavy clay. Consequently the soil was of little use as an absorbent and there was a considerable tendency for the water which drained from the heap to lie on the ground, so that the lower portion of each heap was under anaerobic conditions. In addition, from the time the heaps were made to the end of the three months' period there were heavy rainstorms, which tended to prevent the temperature of the heaps from rising to an optimum. Further, the pineapple leaves added as absorbents shewed little tendency to break down under these weather conditions.

A trial heap made at Klang about a fortnight before the advent of the wet weather shewed normal decomposition in the initial stages, and although decomposition was retarded later it remained considerably more than a fortnight in advance of the heaps made at a later date.

On a large scale such as this, very little can be done to counteract the effect of wet weather. There is no doubt that owing to its original high moisture content normal decomposition of pineapple will be checked by wet weather much more than will a compost made of dried grass and leaves. The only course is to await the advent of drier weather and then open the heaps and expose them to the sun until the moisture content is normal for compost work.

In consequence of the wet weather the heaps were not really ready for use until more than four months had elapsed from the time they were first made and even after this period, the dried leaves, originally added as an absorbent, were not completely decomposed.

It would appear, therefore, that for dealing successfully with pineapple waste, adequate arrangements must be made for draining the land, and any material which distintegrates only with difficulty should be avoided as an absorbent. It is probable that distintegration of pineapple waste would be more rapid if the heap could be made on a platform raised about an inch or two off the ground or if a channel were dug round the heap.

The Value of Composts.

The actual value of the pineapple compost in terms of mineral fertilizer varies to some extent with the weather, but an average figure is given in the table below. This table indicates that 5 tons of finished compost, assuming all nutrients are readily available, is equivalent in manurial value to approximately 1 cwt. rock phosphate, 4 cwt. sulphate of ammonia, and $\frac{1}{2}$ cwt. sulphate of potassium.

It is maintained by Howard (1) and Jones,(7) amongst others, that the main object of composting is to alter the carbon/nitrogen ratio from 40/1 or 50/1 down to 10/1, a ratio which they consider in general fairly constantly retained on inland soils. The view is held that if the carbon/nitrogen ratio is not reduced to this amount, the stimulus of soil bacteria due to the excess of carbon tends to the temporary locking up of nitrogen. While this may be true for tropical climates with well-defined wet and dry seasons, it is doubtful whether it applies equally to lands of the equatorial rain belt, where there are no sharply defined seasons. In Malaya, the disappearance from the soil of added organic matter takes place with almost incredible rapidity.

Composting certainly makes for a lowering of the carbon/nitrogen ratio. Local preparations of compost have never resulted in the carbon/nitrogen ratio falling below 20/1. Examination of the composts from Cameron Highlands, Perak and Kuala Lumpur shows that the ratio in general of the finished product varies between 20/1 and 25/1 as against 15.5/1 obtained in monsoon weather at Indore.

It is not improbable that local climatic conditions have some bearing on this result. In spite of this high ratio the finished product is actually considerably richer in nitrogen than that obtained in India. This carbon/nitrogen ratio can be adjusted readily immediately before use by the addition of about $1\frac{1}{2}$ lbs. of sulphate of ammonia per 100 lbs. of compost.

It should be noted that the mineral content of locally prepared compost is very much lower than that of locally prepared cattle manure, especially in regard to the phosphate content.

A further and most important point in composting is the breaking down of the pentosans, which may be regarded as organic matter not readily attackable by soil bacteria. If the composting process has followed a normal course the pentosan content should be reduced to about 5 per cent. of the dry weight. In the writer's opinion, this breaking down of pentosans is more important than the question of the final carbon/nitrogen ratio.

The table below shows the analysis of typical finished composts:—

Percentage Composition of Compost made from Leaves and Grass and Pineapple Waste (on dry basis.)

Carbon	Nitrogen	C/N Ratio	Pento-sans	Lime Ca 0	Phos-phates P_2O_5	Potash K_2O	Magne-sia MgO	Loss on ignition	Moisture
Leaves and Grass Compost									
35	1.75	21.6	5.1	0.60	0.60	0.55	0.20	51	57
Ordinary Cattle Manure made in open at Serdang.									
—	—	—	5.8	—	1.27	1.18	—	43	50
Bengali Cattle Manure									
—	—	—	11.24	—	1.0	1.09	—	57	66
Pineapple Waste Compost									
35	1.6	22	5.0	1.4	0.43	0.41	0.04	80	67

References.

(1) Dennett, J. H. Suggested at a lecture to the Incorporated Society of Planters in 1924.

(2) Howard & Wad. The Waste Product of Agriculture, published by Melford.

(3) *Malayan Agricultural Journal*, Vol. XX, 1932, page 423.

(4) Greenstreet, V. R. *Malayan Agricultural Journal*, Vol. XVI, 1928, pages 194—203.

(5) Wilshaw, R. G. H. *Malayan Agricultural Journal*, Vol. XIX, 1931, page 593.

(6) Greenstreet, V. R. *Ibid.* and *Malayan Agricultural Journal*, Vol. XVI, 1928, page 8.

(7) Jones, K. B. W. *Planters Chronicle*, Vol. XXXII, No. 6, page 149.

(8) Composting. Agricultural Leaflet, No. 17. Department of Agriculture, S.S. and F.M.S. 1937.

ORYCTES RHINOCEROS L. AND OIL-PALMS.

A Warning.

Oryctes rhinoceros L. has previously been reported as boring the crowns of oil palms and, whilst this beetle is undoubtedly more prevalent on the coconut palm, it has become increasingly evident on oil palms on certain properties. The two sources in which its grubs have been comparatively recently discovered are decaying stumps and logs of the rubber tree and compost heaps. With the disappearance of the rubber material, *Oryctes rhinoceros* L. should not cause further anxiety but, if the making of compost heaps becomes a regular estate practice, Oryctes may, if care is not exercised, develop into a more important pest than hitherto to the oil palm.

Compost on one estate is composed of well-rotted pericarp, cattle manure and ash from burnt fruit bunches. These substances are placed in pits in separate layers and the whole, during a period of about one month, is turned over two or three times. On another property it consists of cattle manure and undecomposed fruit bunches, grass cuttings and similar material, and is stacked in heaps for some two months when, during that period, it is turned over about every two weeks. Cattle manure has been generally known for a long time as a favoured breeding ground for Oryctes, but decayed pericarp fibre and rotted fruit bunches are not so widely recognized. Observations have not been sufficiently extensive to state definitely the exact length of time when pericarp and fruit bunches become sufficiently rotted to attract Oryctes beetles for egg-laying but they suggest that the period is about six months, but under conditions favouring decomposition, this might be considerably less, from three to four months. In this connexion, it may be mentioned that the beetle appears to be attracted to partially burnt fruit bunches sooner than to unburnt similar material and that the grub of Oryctes has been found in the accumulations of palm bunch refuse in the vicinity of stripping sheds.

It should be remembered that whether fresh or decomposed material enters into the composition of compost, cattle manure is one of its constituents and may attract the beetle of Oryctes for egg-laying, but provided that from the commencement and during the course of the preparation of the heaps or stacks all grubs and/or beetles seen are collected and destroyed, the compost should not become a breeding ground for Oryctes.

Compost about 1 in. in thickness at the rate of from 6 to 7 tons per acre is generally placed between the rows of palms in trenches which are about 5 ft. wide and from 3 in. to 6 in. deep and covered with soil. It is considered that, if compost is so applied or if spread on the surface of the soil at the above-stated rate, the grub of Oryctes, even though present in the compost, would be unlikely to reach maturity in a mineral soil but might, however, do so in a soil of an organic or peaty character, and further that the beetle of Oryctes would not be attracted to the compost for the purpose of laying eggs whether the soil is of a mineral, peaty or loamy consistency.

G. H. C.

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Miscellaneous.

FURTHER NOTE ON USE OF CRUDE OIL TO PREVENT DAMAGE BY CRABS.

The January issue of this Journal contained a note by Mr. P. C. Fisher in which, from personal experience, he advocated the use of crude oil to prevent damage to bunds by crabs.

This note has drawn the following comments from Mr. R. J. Maclachlan, who has had much experience of this problem.

"We have been using crude oil, or Diesel Engine Oil, for the last 6 or 7 years. We found it wasteful to pour undiluted oil into the holes, many of which are not vertical so that most of the oil soaks into the sides of the hole instead of at once reaching the lower reaches of the tunnel where the crabs are lurking.

The following is our procedure:—

3 to 4 lbs. of slaked lime are mixed with 3 to 4 gallons of water; to this is added ½ to 1 pint of crude oil and one ounce of arsenical "white ant" powder. The value of the latter ingredient has not been proved by actual experiment, but both lime and crude oil have been tested by controlled experiments.

One or two cigarette tins of the mixture are poured down each active crab hole and the latter then blocked. The treatment is repeated at least once per month. Very rarely is a treated hole again used and in the course of time the crabs almost entirely disappear from the locality. Our experience has been that mild treatment with regularity over a long period is preferable to drastic measures. The former aims at progressively rendering the soil disagreeable to all crabs.

I have never found any evidence that crabs are actually killed by our treatment.

It is instructive to note that after heavy rain which waterlogs the soil, large numbers of the dredger crabs come to the surface and crawl about in a dazed condition. They can then be killed with a stick.

Crabs do not thrive in drained and cultivated soil. We have found it advantageous to dig a small drain about 20 to 30 feet on the inner side of the bund, to intercept seepage. However watertight the bund itself may be, there is horizontal seepage through the soil under the bund.

If the strip of land behind the bund is soaking with brackish water, crabs will flourish there and tunnel into and under the bund itself."

RENT ON LAND PLANTED WITH COCONUTS AND OIL PALMS IN THE F.M.S.

The Federated Malay States Government has decided that the concessions in the matter of rent on coconut and oil palm lands which were in force in 1937 shall be extended until the end of 1938.

The Government, however, reserves to itself the right to refuse any further extension of the concessions beyond the end of 1938 irrespective of the market prices of coconut and oil palm products.

The concessions under reference are as follows:—

(i) COCONUT LANDS: in the case of lands exceeding 10 acres in area:
   (*a*) the rent on planted areas already enjoying the rebate for land cultivated with coconuts under the Land Rules and paying $2 an acre will be reduced to $1 per acre;
   (*b*) unplanted areas will also pay $1 per acre only.

   In the case of lands not exceeding 10 acres in area, the effect of the concession will be to reduce the rent, which is in the majority of cases less than $2 per acre, by half.

(ii) OIL PALM LANDS: a rebate will be given of 50 per cent. of the rent payable with a minimum of $1 per acre on planted and unplanted areas.

Applications for either of these concessions should be made to the Collector of Land Revenue of the district in which the land is situated. The question of the eligibility of applicants for the concession is a matter for the discretion of the State authorities.

DERRIS PLANTING.

The Department of Agriculture is approached from time to time by firms interested in the purchase of derris root, for particulars of growers of this crop in Malaya.

The Agricultural Economist therefore invites planters interested in derris cultivation to notify him early of future production, giving particulars of quantity which will be available, origin of planting material, and stating when harvest is expected.

MARKET FOR PAPAIN.

A firm in Canada is anxious to enter into correspondence with planters who are in a financial position to open up from 50 to 100 acres of papaya for the purpose of producing papain. Further information may be obtained from the Department of Agriculture, Kuala Lumpur. Please quote reference number D.A. 638/37.

Reviews.

Observations on Stem-Rot of the Oil Palm.

By A. Thompson, Special Bulletin, Scientific Series No. 21. Department of Agriculture, Straits Settlements and Federated Malay States, Kuala Lumpur, 1937, 28 pp., 14 plates. Price 50 cents (Straits currency).

Stem rot of the oil palm is serious only in areas of deep peat, or in quartzite valley soils with sand beds approaching the surface, though it may occur, to a lesser extent, on lateritic soils where rocky outcrops form a hard pan.

Mr. Thompson shews that the commonest form of stem rot disease is caused by the fungus *Fomes noxius* which penetrates the stem tissue *via* the leaf-bases. Palms are rarely killed until two or three years after infection. The author also gives an account of the fungus *Ganoderma lucidum* which is regarded as a facultative parasite and of *Fomes lignosus* which appears to be saprophytic on this host.

Regarding treatment of palms affected by stem-rot, excision of decayed tissue is advocated only for areas, particularly of deep peat, where economic yields are still obtainable and where, if the diseased palms were felled and supplies planted, growth of the supplied palms is unlikely to be satisfactory.

Although the disease penetrates through the cut leaf-bases, preventive painting of the cut surface of leaf-bases after pruning is not recommended, but as an alternative, the author suggests that "hat-peg" pruning, which helps to avoid wounds, confers a measure of protection.

"Stem-rot has been reported from the majority of oil palm estates in Malaya, but, except in areas where soil conditions are unfavourable to vigorous growth, it has not been extensive and cannot be considered as a serious menace to the industry, although when it was first discovered it had affected so many palms in the area involved, that it was regarded with considerable disquietude."

While these observations and conclusions are reassuring the fact remains that considerable loss may be occasioned by stem-rot of the oil palm, and planters will be well advised to make themselves familiar with the results of this investigation.

D. H. G.

Journal of the Rubber Research Institute of Malaya.

Vol. 8 No. 2, January 1938. Rubber Research Institute of Malaya, Kuala Lumpur, 143 pp. Price 50 cents (Straits Currency).

The current number of the Journal of the Rubber Research Institute of Malaya contains the following articles in addition to the Editorial and two book reviews:—

Experiments with Economic Tapping Systems (1) Part VI by C. C. T. Sharp.
Experiments on Tapping Systems by C. C. T. Sharp.
Note on the Introduction of New Clones for Use on Estates.
Report on a visit to Malaya, Java and Sumatra by R. K. S. Murray.
The Giant Snail *Achatina fulica* (Fer.) by F. Beeley.
Oidium Heveae by F. Beeley.
Nodule Bacteria and Leguminous Cover Plants by F. Beeley.
Selection of Rubber Factory Equipment by J. H. Piddlesden.
The Constituents of Hevea, Parts II, III and IV by K. C. Roberts.
The Uses of Statistics in Field Experiments with Rubber Trees by H. J. Page.

The Editor of the Journal summarizes the contents of this interesting number as follows:—

Tapping Systems.

" The previous issue of this *Journal* contains a paper by Mr. C. C. T. Sharp dealing with the results of the experiment on tapping-systems on Seventh Mile Estate for the third year, June 1935 to May 1936. The present issue contains a further paper by Mr. Sharp giving the results of the same experiment for the fourth year, June 1936 to May 1937, together with another paper by Mr. Sharp, being the substance of a lecture given at the Annual Conference of the Incorporated Society of Planters in September of last year, in which the results of this experiment for the first four years are summarized and discussed. Little need here be added to the editorial comments on the above-mentioned paper in the previous issue (page 2). In view of the uncertainty as to the behaviour of rubber trees in a lower yield-class, in relation to different tapping systems, further experiments are now being laid down on such rubber trees. It is interesting to record that independent evidence from various sources including these experiments agrees in showing that, so far as the beneficial effect on yield is concerned, resting from tapping need not exceed three months.

Commercial Planting of New Clones.

" One of the vexations of agricultural research is the long time which usually must elapse before the results of experiments can confidently be recommended for practical application. This is particularly true for a long-term crop such as the rubber tree. The practical planter who is in a position to use a promising new clone would often like to "back his fancy" by using it for commercial planting,

notably in connection with a replanting programme. The advice given by the Institute, however, must be as free from uncertainty as is reasonably possible, and for that reason the Institute's policy is based on the principle that the value of a new clone can be assessed with sufficient certainty only when the first buddings of the clone are at least 10 years old, and have been tested under a normal tapping-system for not less than five years. In order to speed things up as much as possible it is naturally desirable that the preliminary period of selection and testing should not unduly delay the critical testing of such clones as may be finally selected. There are different ways of setting about this; these are described and discussed in a circular written by Mr. Mann, which has recently been issued from the Botanical Division, and which is reprinted in this issue of the *Journal* for general information.

Report on Mr. Murray's Visit.

" It is always stimulating to compare planting practices and opinions in different countries. This is particularly true in relation to bud-grafting in its technical and commercial aspects. This was the principal *raison d'être* of the visit of Mr. R. K. S. Murray, Botanist and Mycologist to the Rubber Research Scheme (Ceylon), to Malaya and the Netherlands East Indies at the end of 1936. Extensive extracts from his report on this visit are therefore included in this issue of the *Journal*. Much in this report will be familiar to many Malayan planters, and to agricultural scientists concerned with rubber-growing. It is valuable, however, that facts or opinions on matters which do not yet command common agreement among all planters, should be seen through the eyes of a visitor from another country, who is able to combine the necessary scientific knowledge to enable him to form an opinion, with a greater freedom from bias or prejudice than the local man is liable to have. It is also of great value to study the way in which differences in soils and other environmental or economic conditions, as between different rubber-growing countries, affect the relative importance of different aspects of rubber-planting. The published extracts from Mr. Murray's report can be read with much profit in these connections, and here it suffices to point out that with regard to the principal object of the visit—yields of bud-grafted rubber in commercial practice—Mr. Murray states that "these results show beyond the possibility of doubt that yields greatly in excess of those to be expected from unselected seedling material at similar ages are being obtained in estate practice, and it is almost certain that appreciably larger yields will be obtained from younger clearings which are planted with better clones".

The Giant Snail.

" This is one of the most troublesome pests in many districts, frequently causing serious damage both to young rubber plants and to cover plants. A very notable advance in the methods for the control of this pest consists in the discovery—of unknown origin—of the fact that "Meta", material hitherto used primarily as a dry fuel for domestic purposes, for heating kettles and the like, is a deadly poison for these pests. The method of its application, in the form of a bran-bait, and the

results of tests carried out at the Institute's Experiment Station, are dealt with in a paper by Mr. Beeley in this issue. The method would prove needlessly expensive as a sole means of keeping the pest in check year-in, year-out; but it seems to be unapproached by any other known method, as a means of rapidly reducing an infestation to a low level such that it can then be kept permanently in check by the use of calcium arsenate-lime-cement bricks.

Oidium Heveae.

" Mr. Beeley's report on the incidence of Hevea leaf-mildew in 1937 has been purposely held back until this issue of the *Journal* in the belief that it will be read with greater interest at a time when this year's Oidium season is imminent. The climatic conditions during the latter part of 1936 and the early part of 1937 were particularly favourable for the study of the relation between the incidence of this disease and meteorological conditions. On the whole the attack in 1937 was quite a mild one, and there is nothing to indicate that the prevalence or virulence of the disease is on the increase in this country.

Leguminous Cover-Crops.

" Although leguminous cover-crops can commonly be established with comparative ease in areas of young rubber trees, on the majority of Malayan soils it proves extremely difficult or impossible to establish or retain them in a mature stand. These failures are commonly attributed to the effect of heavy shade. That this cannot be the whole story is amply demonstrated by the fact that in some areas, exceptional but none the less authentic in Malaya, but more particularly in Sumatra, leguminous creeping covers flourish under shade. There must therefore be other factors at work. One of these is now well-recognised to be phosphate-deficiency, and phosphatic manuring may be one of the essential factors for success in the establishment and maintenance of such covers on many soils. A further important factor is that of the presence of the necessary nodule organism. Without the presence of the correct strain of organism, leguminous plants cannot form the nodules on their roots, on which they normally depend for their supply of nitrogenous plant-food. This aspect of the subject is now being actively investigated at the Institute and this issue of the *Journal* contains a paper by Mr. Beeley, being a reprint of a lecture given at the Annual Conference of the Incorporated Society of Planters in September last, which deals in some detail with the scientific aspects of this subject and with their practical application. It may well be that the effect of shade is the "last straw" for leguminous crops already suffering from deficiency of phosphate and perhaps other mineral nutrients, together with absence of the correct strain of nodule bacteria, and that if these two deficiencies are remedied the establishment and the maintenance of leguminous creepers under mature rubber on Malayan soils will be more generally feasible.

Factory Equipment on Estates.

" Marked advances have been made in recent years in the design of the equipment in estate factories, particularly with regard to sheeting batteries and smoke-houses. Such progress has now reached the stage that, to quote from the summary of the paper by Mr. Piddlesden in this issue "improvement and economies in the immediate future will be effected by attempts to make the best use of existing types of equipment rather than by violent departures from current designs." The Institute is constantly being asked to advise on the organisation and lay-out of estate factories, and the present paper summarizes the position, and in particular discusses the question of the proper co-ordination, in space and in time, of the various pieces of equipment and machinery, and their working, which are concerned in the conversion of field latex into smoked sheet.

The Composition of Latex.

" The previous volume of this *Journal* contains the first paper by Dr. Roberts on the results of his work on the composition of Hevea latex. The so-called "non-rubber solids" were shown to consist of, and were separated into, several well-defined fractions, the further study of which promised to throw considerable light not only on practical problems of latex processing and rubber manufacture, but also on the important fundamental problems of the functions of latex in the tree and the mechanism of its formation. This work has now been carried considerably further, and the present issue contains three more papers by Dr. Roberts. From the technological point of view one of the most important aspects of this work is that of its bearing upon the variability of raw rubber. There is a long-standing desire on the part of the manufacturers of rubber goods for standardization of the raw material, though unanimity regarding the standards required has not yet been evinced. Variability of raw rubber depends partly upon variations in procedure in the estate factory during the conversion of latex into dry rubber, but it depends even more upon inherent variations in the latex itself, as obtained from trees of varying age and origin, on varying soils, and under varying climatic, meteorological, and tapping conditions. Dr. Roberts' work is an important contribution to this latter aspect of the subject, for by the study of the different characteristic fractions of the latex solids and their variation in amount and in composition, it should ultimately prove possible to interpret these inherent variations and the variations in vulcanisation and other properties, in chemical terms. Until the chemical nature of the variations in latex have been elucidated, it is impossible to say with certainty to what extent the effect of these variations could be obviated by changes in the subsequent treatment of the latex, or what the nature of those changes should be.

Modern Field Experiments.

" Experimental work in the field on the many and varied aspects of the cultivation of Hevea is now wide-spread. Not only is the programme of such experiments which are being carried out by the Institute or under the supervision of its staff, now a very extensive one, but many estates are also carrying on experimental

work of their own. Unless proper safeguards are available in the interpretation of the results of experiments, erroneous conclusions may easily be drawn, and if such erroneous conclusions are applied commercially on estates, considerable financial loss may result. During the past 10 or 15 years there has been a virtual revolution in the design and interpretation of field experiments, following the application of mathematical statistics to the subject, in which application R. A. Fisher was the pioneer and is still recognised as the leader. The mathematical considerations involved in the design of modern field experiments, and in the interpretation of their results, are too abstruse to be readily intelligible to any but the professional mathematician. On the other hand the reasons why ill-designed experiments may be so misleading as to be worse than useless, and the general principles underlying the design of modern experiments and the interpretation of their results, can be explained in non-mathematical language. An attempt has been made to do this in a paper by the Director in the present issue, which is the substance of a lecture given at the Annual Conference of the Incorporated Society of Planters in September last. It is believed that planters who are interested in carrying out experiments, but who are suspicious of the demands of agricultural scientists regarding the way in which such experiments should be laid out, will find that perusal of this paper helps to allay their suspicions; and that it will make them realize that the extra trouble involved in carrying out a properly-designed experiment is likely to be well worth while, by giving them results of a known reliability as compared with the possibility of drawing erroneous and expensive conclusions from wrongly-designed experiments."

Departmental.

FROM THE DISTRICTS.

Compiled by the Chief Field Officer from Monthly Reports of Agricultural Officers.

February, 1938.

The Weather.

In North Kedah, some heavy showers during the first week of the month brought the rainfall well above the average for February. Heavy rainfall at this time of year is exceptional, for a dry January and February is a regular and pronounced feature of the North Kedah climate.

In Penang and Province Wellesley, similar but less severe showers also fell during the first week but the rainfall for the month was below the average.

Hot and dry weather prevailed generally and, with the exception of North Kedah, precipitation was below the average for the month at most stations from which records are received. These dry conditions were specially marked in Malacca and the adjoining areas of Negri Sembilan and Johore. On the East Coast rainfall was well below normal for the month both in Kelantan and Pahang.

Remarks on Crops.

Rubber.—The price of smoked sheet remained steady at about last month's quotations in most parts of the country. There was a tendency towards slightly higher prices for coupons and export rights with an equivalent decline for the price of rubber not covered by such rights.

In several reports details are given regarding the prices paid to tappers by small-holders. In Selangor, seven to eight cents a *kati* (1 1/3 lbs.) has been a common contract price and attempts made during the month to reduce this in Ulu Langat District were not altogether successful. In Negri Sembilan four to five cents a *kati* is now commonly paid, although the rate in some localities of this State still remains as high as seven cents. The common practice among small-holders of paying the tapper by allotting him a fixed proportion of the produce, known generally as the *bagi dua* system, is somewhat more complicated than formerly as the result of restriction regulations. From Perak South it is reported that the tapper still receives only half the rubber he obtains, but a common division in Selangor now is one-third to the owner and two-thirds to the tapper. It would seem that in this arrangement no account is taken of export rights, the whole of the coupons being retained by the owner so that the tapper can only sell his share of the produce at uncouponed prices.

The census of rubber sold by dealers in Batang Padang during 1937 is proving a lengthy business, owing to the difficulty of getting precise information from dealers' records. An experimental grading scheme has been started by the Asiatic Rubber

Instructor at Ijok in Kuala Selangor, in order to obtain some information as to what advantages may be expected from a grading scheme for small-holders' rubber and as to the methods most likely to be successful if any official grading scheme were instituted.

Padi.—It is as yet too early to venture an estimate of the Kedah crop, but both yields obtained from Test Stations and the general appearance of the padi in the fields indicate that the crop will be appreciably below average. An exception is the Baling District where good yields have been obtained and at the Test Station for the District (Pulai Station) yields of about 600 gantangs to the acre were harvested.

In Krian and the adjoining area of Sungei Acheh in Province Wellesley harvesting is in progress but it is anticipated that it will be more protracted than usual. The sealing of bags of the strain Seraup 48 in being done by Departmental officers in Krian as a guarantee of its suitability for the bonus of 10 cents a picul offered by the Government mills for this strain. Up to the end of the month 4,774 bags had been sealed and 90 per cent. of this received the bonus. Attempts are being made to bring the inspection to a higher standard so as to ensure that all sealed padi is definitely up to the standard required for the bonus. At present the grower is receiving on an average about 7.5 cents of the bonus of 10 cents which is paid the middleman who sells the padi to the mills. It is considered that, given the reliability aimed at in the inspection and sealing, the grower should receive at least eight of the ten cents premium.

Harvesting is in progress in the Sungei Manik area of Perak. It is too early to estimate the crop by comparison with that of last year, but in some areas of Stage II better crops are being reaped than last season.

At Panchang Bedena in Selangor a fairly good crop is expected notwithstanding the low rainfall through most of the growing period.

Both in Malacca and Kelantan the crop is expected to be better than that of last season.

Agricultural and Padi Stations.—There is nothing of special interest to record. During the dry weather only routine work could be done on Agricultural Stations and harvesting is either in progress or completed at most of the Padi Stations.

DEPARTMENTAL NOTES.

Visit of Sir Frank A. Stockdale, K.C.M.G., C.B.E.

Sir Frank A. Stockdale, Agricultural Adviser to the Secretary of State for the Colonies, concluded his official visit to Malaya on 4th March, 1938. He arrived in Penang on 28th February, and thus spent five weeks in this country.

Sir Frank first inspected centres of agricultural activity in Penang and Province Wellesley and then proceeded to Kedah. Travelling south he visited coconut and rubber estates, the Krian padi area, the Sungei Manik Irrigation Scheme and various Agricultural Stations in Perak.

A tour was made to Kelantan, Trengganu and Pahang after which the Research Stations and Headquarters of the Department of Agriculture and the Rubber Research Institute were inspected. A pineapple plantation and factory at Klang, rubber replanting and manuring were included in his tour of Selangor, Negri Sembilan and Malacca. Some days were spent in Singapore and Johore where several estates and Experiment Stations were inspected.

Returning to Kuala Lumpur, Sir Frank next proceeded for a two-day inspection of the agricultural activities of Cameron Highlands, after which he sailed for the Netherlands Indies.

Rural Lecture Caravan.

The Rural Lecture Caravan, operated jointly by the Departments of Agriculture and Co-operation and the Rubber Research Institute of Malaya, met with an accident in Negri Sembilan early in January which caused irreparable damage to the Caravan.

In consequence of this accident several tours were abandoned. Steps were immediately taken to equip a motor lorry for the resumption of the programme. This has been accomplished and the tours have now been resumed.

Meeting of the Agricultural Advisory Committee.

A meeting of the Agricultural Advisory Committee was held at the Department of Agriculture, Kuala Lumpur, on 3rd March, 1938, at which Sir Frank Stockdale was present. A résumé of the minutes of this meeting will appear in the *Malayan Agricultural Journal*, April 1938.

Statistical.

MARKET PRICES.

February, 1938.

Major Crops.

Rubber.—The market continued at a low level in February, but with a slight improvement in the second half of the month. Spot loose opened in Singapore at $22\frac{3}{4}$ cents per lb., and after minor fluctuations rose to $23\frac{1}{8}$ on the 16th and to $24\frac{3}{8}$ on the 23rd, closing at $23\frac{5}{8}$ cents.

The average price for the month of No. 1. X. Rubber Smoked Sheet was 23.13 cents per lb., as compared with 23.08 cents in January. The London average price was 7.03 pence per lb., and the New York price 14.65 cents gold, as compared with 7.07 pence and 14.54 cents gold in January.

Prices paid for small-holders' rubber at three centres during the month are shewn in Table I.

Table I.

Weekly Prices Paid By Local Dealers for Small-Holders' Rubber, February, 1938.

(Dollars per Picul.)

Grades.	Kuala Pilah, Negri Sembilan.			Kuala Kangsar, Perak.		Batu Pahat, Johore.		
	3	17	24	9	23	9	16	23
Smoked sheet	28.50	27.98	28.79	26.90				
Unsmoked sheet	26.60		26.00		26.00	25.25	25.30	26.65
Scrap	20.00							

Transport by F.M.S.R. lorry service Kuala Pilah to Seremban 12 cents per picul, to Malacca excluding duty, 25 cents per picul, by rail Seremban to Penang $1.24 per picul, Seremban to Singapore $8.00 per ton.

Transport from Batu Pahat to Singapore by lorry excluding duty, 90 cents per picul.

Transport from Kuala Kangsar to Prai by railway $6.20 per ton.

Transport from Kuala Kangsar to Singapore by railway $10.00 per ton (minimum consignment 5 tons).

At Kuala Pilah the standard deduction for moisture in unsmoked sheet is 5 per cent.

At Kuala Kangsar the standard deduction for moisture in unsmoked sheet is 10 per cent.

No purchases at Batu Pahat on the 2nd February, at Kuala Kangsar on the 2nd and 16th and at Kuala Pilah on the 10th February.

Palm Oil.—Prices fell further during February but there was a slight improvement at the close and the month's quotations for the Malayan commodities are given in Table II.

Table II.
Prices of Palm Oil and Palm Kernels.

Date 1938.	Palm Oil in Bulk, c i.f. landed weight Liverpool/ Halifax.	Palm Kernels, c.i.f. landed weight London/ Continent
	per ton	per ton
February 4	£ 16. 10. 0	£ 10. 0. 0
,, 11	16. 0. 0	9. 10. 0
,, 18	15. 10. 0	9. 5. 0
,, 25	16. 15. 0	9. 15. 0

Copra.—The copra market continued to weaken considerably in February, and the level of $3.45 per picul reached on the 17th was the lowest since January 1935. The average price for the month of the sun-dried grade was $3.75 per picul, the mixed grade being 40 cents lower. The average prices for January were $4.41 and $4.05 respectively.

Copra cake continued unchanged at $1.80 per picul.

Rice.—The average wholesale Singapore prices of rice per picul in January were as follows:—Siam No. 2 (ordinary) $4.11; Rangoon No. 1 $3.95; Saigon No. 1 $4; as compared with $4.14, $3.95, and $3.97 in December and with $4.95, $3.67 and $4.50 in January 1937.

The average retail prices in cents per gantang of No. 2 Siam rice in January were:—Singapore 28, Penang 32, Malacca 28, as compared with 28, 36 and 29 in December.

The average declared trade value of imports during January was $4.04 per picul as compared with $3.98 in December and $4.09 in November.

Padi.—The price of padi at the Government Rice Mills, Perak, was raised to $2.10 per picul. Retail prices of padi ranged from 6 to 15 cents per gantang.

Pineapples.—There was no change in the prices of canned pineapples per case during February and they were:—G.A.Q.: Cubes $2.70, Sliced Flat $2.65, Sliced Tall $2.80; Golden Quality: $2.85, $2.80 and $2.95 respectively.

Prices of fresh fruit per 100 for canning were as follows:—Singapore 80 cents to $1.40; Johore 1st quality 60 cents to $1, 2nd quality 40 to 80 cents, 3rd quality 20 to 50 cents. The Selangor factories were closed.

Beverages.

Tea.—Eight consignments of Malayan tea were sold on the London market during February. Three consignments were of upland tea and were sold at average prices of 1s. 1½d., 1s. 2¼d., and 1s. 2½d. per lb. respectively. The lowland tea was sold at average prices ranging from 1s. 0¼d. to 1s. 1¾d. per lb.

Average London prices per lb. during February for consignments of tea from other countries were as follows:—Ceylon 1s. 4.59d., Java 1s. 0.48d., Indian Northern 1s. 2.14d., Indian Southern 1s. 2.72d., Sumatra 11.49d.

The latest Colombo average prices available quoted from *The Weekly Tea Market Report*, 22nd February 1938, of the Colombo Brokers' Association, are as follows, in rupee cents per lb.: High Grown Teas 86 cents, Medium Grown Teas 74 cents, Low Grown Teas 65 cents.

Coffee.—Prices remained almost unchanged, and averages per picul were:—Sourabaya $13.12 to $14.12; Palembang $10.23 to $11.30.

Prices in Singapore of other varieties of coffee were as follows (per picul):—Liberian $14; Excelsa $10; Robusta $7.

Spices.

Arecanuts.—The range of Singapore prices per picul during February was as follows:—Splits $4.56 to $7.06; Red Whole $6.69 to $9.69; Sliced $5.69 to $6.88.

The averages of the Singapore Chamber of Commerce quotations per picul were:—Best $7.81, Medium $7.31, Mixed $6.88.

Pepper.—Prices were higher in Singapore during February with further improvement in the last week of the month. Average prices per picul for the month were as follows:—Singapore Black $9, Singapore White $14.50, Muntok White $15, as compared with $8.05, $13.50 and $14 respectively in January.

Nutmegs.—The Singapore market weakened considerably in February, the price of both 110's and 80's falling from $38 per picul to $32, with an average of $34.50 per picul as compared with $41.40 in January.

Mace.—Siouw was quoted throughout the month at $95 per picul, and Amboina at $75, as compared with January averages of $98 and $82 per picul respectively.

Cloves.—Nominal quotations remained unchanged at $40 per picul for both Zanzibar and Amboina.

Cardamoms.—Green cardamoms were quoted in the Ceylon Chamber of Commerce reports for February at Rs. 1.35 to Rs. 1.52, falling at the close to Rs. 1.10 to Rs. 1.35 per lb.

Miscellaneous.

Derris (*Tuba Root*).—Limited buying by overseas consumers further depressed prices during February. Average prices per picul for the month were: roots sold on rotenone content $22, roots sold on a basis of ether extract $14, as compared with $25 and $15 respectively in January.

Gambier.—No. 1 Cube was quoted throughout February at $16 per picul as compared with an average price of $15.60 in January. Block fell to $7 per picul, averaging $7.56 as against $7.90 in January.

Tapioca.—Seed Pearl and Medium Pearl remained unchanged at $4.80 and $5.20 per picul respectively, while Flake Fair was quoted throughout the month at $4.25 as compared with an average price of $4.45 in January.

Sago.—Pearl, Small Fair, averaged $4.02 per picul, and Flour, Sarawak Fair, $2.35, as against $4.25 and $2.44 respectively in January.

Tobacco.—The general range of prices per picul was as follows:—1st quality $24 to $44, 2nd quality $23 to $38, 3rd quality $8 to $25. In Johore the range was from $12 to $50, and for prepared tobacco from $32 to $120. In Negri Sembilan the range for prepared tobacco was: 1st quality $55 to $60, 2nd quality $40 to $55, 3rd quality $35 to $45, and in Kelantan $100, $82.50 and $62.50 respectively.

The above prices are based on London and Singapore daily quotations for rubber; on the Singapore Chamber of Commerce Weekly Reports for the month and on other local sources of information. Palm oil reports and certain coffee prices are kindly supplied by Messrs. Guthrie & Co. Ltd., Kuala Lumpur; the Singapore prices for imported coffee and arecanuts by the Lianqui Trading Company of Singapore, and derris prices by Messrs. Kohyei & Co., Singapore.

1 picul = 133⅓ lbs. The Dollar is fixed at two shillings and fourpence.

Note.—The Department of Agriculture will be pleased to assist planters in finding a market for agricultural produce. Similar assistance is also offered by the Malayan Information Agency, 57 Trafalgar Square, London, W.C. 2

GENERAL RICE SUMMARY*

January, 1938.

Malaya.—Imports of foreign rice during January were 59,362 tons,† and exports 16,179 tons, net imports being 43,183 tons as compared with 43,387 tons in 1937.¶

Of the imports during January 52 per cent. were consigned to Singapore, 13 per cent. to Penang, 6 per cent. to Malacca, 25 per cent. to the Federated Malay States and 4 per cent. to the Unfederated Malay States. The foreign imports by countries of origin were as follows (in tons, percentages in brackets):—Siam 40,168 (67.7), Burma 16,629 (28.0), French Indo-China 1,612 (2.7), other countries 953 (1.6).

Of the January exports 74 per cent. were consigned to the Netherlands Indies and 26 per cent. to other countries. The various kinds of rice exported were as follows (in tons, percentages in brackets):—Siam 13,050 (80.7), Burma 2,378 (14.7), French Indo-China 586 (3.6), parboiled 48 (0.3), local production 177 (0.7).

India and Burma.—Burma's total exports of rice and bran (*Bangkok Times,* 21st January 1938) from 1st January to 11th December 1937, were 3,119,566 tons as compared with 3,059,451 tons in 1936, an increase of 2 per cent.

According to the final forecast (15th February 1938) of the rice crop in Burma for the 1937-38 season, the area likely to mature is 12,534,300 acres, an increase of 426,400 acres as compared with the final figures for the previous season.

The surplus available for export is now estimated at 3,100,000 tons of rice and rice products which may be taken as equivalent to 4,189,000 tons of padi.

Siam.—According to the fourth report on the rice crop of Siam for the 1937-38 season, the cultivated area is given approximately at 7,812,638 acres, and the damaged area at 940,655 acres. The estimate of the exportable surplus remains unchanged at 1,583,333 tons.

Japan.—The latest information available was published in the October 1937 Summary.

French Indo-China.—Entries of padi into Cholon during January were 122,060 tons as compared with 141,498 tons in 1937, a decrease of 13.7 per cent. Exports of rice for the same month were 87,962 tons, as compared with 88,761 tons in 1937, a decrease of 0.9 per cent.

The Netherlands Indies.—The latest information available was published in the October 1937 Summary.

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* Abridged from the Rice Summary for January 1938 compiled by the Department of Statistics, Straits Settlements and Federated Malay States.

† Ton = long ton (2,240 lbs.)

¶ It is to be understood throughout the summary that all comparisons and percentage increases or decreases are in relation to the corresponding period of 1936 or 1937.

Ceylon.—Imports of rice during January were 39,974 tons as compared with 48,852 tons in 1937, a decrease of 18.2 per cent. Of these imports 12.6 per cent. were from British India, 76.9 per cent. from Burma, 1.9 per cent. from the Straits Settlements, and 8.6 per cent. from other countries. The corresponding figures for 1937 were 14.7, 70.9, 0.6 and 13.8.

Europe and America.—Shipments from the East to Europe during 1937 totalled 1,138,831 tons as compared with 1,386,012 tons in 1936, a decrease of 17.8 per cent. Of the 1937 shipments 37.9 per cent. were from Burma, 56.2 per cent. from Saigon, 4.4 per cent. from Siam and 1.5 per cent. from Bengal. The corresponding percentages for 1936 were 22.0, 67.5, 9.8 and 0.7.

Shipments to the Levant during 1937 totalled 16,296 tons as compared with 13,699 tons in 1936, an increase of 19 per cent. Shipments to Cuba, West Indies and America during 1937 totalled 227,958 tons, a decrease of 7.8 per cent. as compared with 247,329 tons in 1936.

FERTILIZER PRICES, FEBRUARY, 1938.

The following are the prices at the end of February, 1938, of some of the more important fertilizers. All quotations are *ex* Port Swettenham, F.M.S., or Singapore.

Product.	Analysis				Price per ton $
	Nitrogen (N)	Phosphoric Acid (P_2O_5)		Potash (K_2O)	
		Soluble	Insoluble		
Sulphate of Ammonia ...	20	—	—	—	72.75
Calcium Cyanamide ...	20.6	—	—	—	80.00
Muriate of Potash ...	—	—	—	50	112.00
Sulphate of Potash ...	—	—	—	48	112.00
Superphosphate (concentrated) ...	—	39 - 40	—	—	105.00
Superphosphate ...	—	16 - 18	—	—	60.00
Basic Slag ...	—	16	—	—	50.00
Rock Phosphate (Christmas Island) ...	—	11*	38‡	—	33.50
Rock Phosphate (very finely ground Gafsa) ...	—	11*	26 - 28‡	—	40.00
Lime ...	—	—	—	—	20.00

* Citric soluble. ‡ Total.

MALAYAN AGRICULTURAL EXPORTS, JANUARY, 1938.

PRODUCT.	Net Exports in Tons		
	Year 1937	January 1937	January 1938
Arecanuts ...	30,084	4,087	3,084
Coconuts fresh † ...	95,223†	4,939†	5,043†
Coconut oil ...	39,762	2,579	3,058
Copra ...	75,592	4,275	5,690
Gambier, all kinds ...	1,955	126	181
Copra cake ...	15,026§	1,097§	653
Palm kernels ...	7,312	594	696
Palm oil ...	42,787	1,822	4,494
Pineapples canned ...	80,502	6,316	5,631
Rubber ¶ ...	503,127¶	39,909¶	40,024¶
Sago,—flour ...	15,478	1,812	39
,, —pearl ...	3,759	314	390
,, —raw ...	8,256*	591*	499*
Tapioca,—flake ...	1.058	143	101
,, —flour ...	2,393*	23*	247*
,, —pearl ...	18,786	1,875	1,261
Tuba root ...	573	94	25

† hundreds in number. * net imports. ¶ production. § gross exports.

MALAYAN PRODUCTION OF PALM OIL AND KERNELS

(In long tons, as declared by Estates)

Month 1938	Palm Oil		Palm Kernels	
	F.M.S.	U.M.S.	F.M.S.	U.M.S.
January	2,241.7	1,309.2	383.7	232.0
January 1937	1,984.8	1,403.9*	360.4	232.8*
Total for the year 1937 ...	27,733.5	17,932.8	5,094.7	2,811.4

Stocks on estates at 31st January, 1938 were: palm oil 3,977 tons; palm kernels 775 tons.

* Revised figures for U.M.S.

MALAYAN RUBBER STATISTICS

ACREAGES OF TAPPABLE RUBBER ACTUALLY TAPPED AND NOT TAPPED ON ESTATES OF 100 ACRES AND OVER, FOR THE MONTH ENDING 31ST JANUARY, 1938.

STATE OR TERRITORY	Estimated Acreages of Tappable Rubber	Actual area tapped during the month Acreage	Percentage of (3) to (2)	ACREAGES OF TAPPABLE RUBBER NOT TAPPED						AREA OF TAPPABLE RUBBER NEVER BEEN TAPPED		Total area not tapped (5) + (7) + (9)	Percentage of (13) to (2)
				ESTATES WHICH HAVE ENTIRELY CEASED TAPPING		On estates which have partly ceased tapping							
						Otherwise than under rotational systems		Under rotational systems					
				Acreage	Percentage of (5) to (2)	Acreage	Percentage of (7) to (2)	Acreage	Percentage of (9) to (2)	Acreage	Percentage of (11) to (2)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
S. S.—													
Province Wellesley ...	43,658	26,479	60.7	—	—	8,510	19.5	8,669	19.8	482	1.1	17,179	39.3
Malacca ...	122,454	80,957	66.1	1,176	1.0	8,885	7.2	31,436	25.7	2,297	1.9	41,497	33.9
Penang ...	2,513	1,696	67.5	—	—	681	27.1	136	5.4	72	2.9	817	32.5
Singapore ...	32,694	21,593	66.1	1,547	4.7	5,111	15.6	4,443	13.6	145	0.4	11,101	33.9
Total S.S. ...	201,319	130,725	64.9	2,723	1.4	23,187	11.5	44,684	22.2	2,996	1.5	70,594	35.1
F. M. S.—													
Perak ...	290,291	211,172	72.7	774	0.3	26,681	9.2	51,664	17.8	7,374	2.5	79,119	27.3
Selangor ...	330,432	248,557	75.2	1,247	0.4	20,229	6.1	60,399	18.3	7,140	2.2	81,875	24.8
Negri Sembilan ...	257,005	186,952	72.7	1,567	0.6	21,877	8.5	46,609	18.2	8,300	3.2	70,053	27.3
Pahang ...	85,641	61,323	71.6	942	1.1	14,605	17.1	8,771	10.2	7,374	8.6	24,318	28.4
Total F.M.S. ...	963,369	708,004	73.5	4,530	0.5	83,392	8.6	167,443	17.4	30,188	3.1	255,365	26.5
U. M. S.—													
Johore ...	475,800	352,736	74.1	3,799	0.8	54,691	11.5	64,574	13.6	34,118	7.1	123,064	25.9
Kedah ...	199,411	150,265	75.3	3,326	1.7	9,563	4.8	36,257	18.2	5,623	2.8	49,146	24.7
Kelantan ...	31,161	22,338	71.7	263	0.9	3,935	12.6	4,625	14.8	2,365	7.6	8,823	28.3
Trengganu (*b*) ...	4,817	3,172	65.8	—	—	100	2.1	1,545	32.1	100	2.1	1,645	34.2
Perlis (*c*) ...	1,347	800	59.4	—	—	94	7.0	453	33.6	94	7.0	547	40.6
Brunei ...	5,054	3,369	66.7	—	—	668	13.2	1,017	20.1	899	17.8	1,685	33.3
Total U.M.S. ...	717,590	532,680	74.2	7,388	1.1	69,051	9.6	108,471	15.1	43,199	6.0	184,910	25.8
Total MALAYA ...	1,882,278	1,371,409	72.9	14,641	0.8	175,630	9.3	320,598	17.0	76,383	4.1	510,869	27.1

Notes:—(*a*) The acreage shown in column (11) is included in columns (5) and (7).
(*b*) Registered companies only.
(*c*) Rendered quarterly.

MALAYAN RUBBER STATISTICS — TABLE I

STOCKS, PRODUCTION, IMPORTS AND EXPORTS OF RUBBER, INCLUDING LATEX, CONCENTRATED LATEX AND REVERTEX, FOR THE MONTH OF JANUARY, 1938, IN DRY TONS.

State or Territory	Stocks at beginning of month 1			Production by Estates of 100 acres and over		Production by Estates of less than 100 acres estimated 2		Imports				Exports including re-exports				Stocks at end of month			Consumption 3	
								during the month		January 1938		during the month		January 1938					during the month	Jan. to 1938
	Ports	Dealers	Estates of 100 acres and over	during the month	Jan. 1938	during the month	Jan. 1938	Foreign	From Malay States & Labuan	Foreign	From Malay States & Labuan	Foreign	Local	Foreign	Local	Ports	Dealers	Estates of 100 acres and over		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
MALAY STATES :—																				
Federated Malay States ...	...	9,717	13,430	14,232	14,232	7,154	7,154	Nil	Nil	Nil	Nil	12,987	4,828	12,987	4,828	...	11,892	14,808	18	18
Johore ...	...	4,795	4,839	6,047	6,047	3,197	3,197	Nil	31	Nil	31	2,468	7,491	2,468	7,491	...	3,547	5,403	...	...
Kedah ...	...	586	3,543	3,754	3,754	1,328	1,328	Nil	Nil	Nil	Nil	2,444	2,399	2,444	2,399	...	458	3,910	...	...
Perlis ...	...	6	19	17	17	31	31	Nil	Nil	Nil	Nil	Nil	37	Nil	37	...	14	22	...	...
Kelantan ...	...	884	202	377	377	411	411	Nil	Nil	Nil	Nil	212	616	212	616	...	751	295	...	...
Trengganu ...	...	55	50	297	297	148	148	Nil	Nil	Nil	Nil	Nil	445	Nil	445	...	55	50	...	...
Brunei ...	...	Nil	75	56	56	55	55	...	...	...	...	...	90	...	90	...	18	78	...	...
Total Malay States	...	16,043	22,158	24,780	24,780	12,324	12,324	Nil	31	Nil	31	18,111	15,906	18,111	15,906	...	16,735	24,566	18	18
S. SETTLEMENTS :—																				
Malacca ...	...	2,217	1,311	1,509	1,509	384	384	Nil		Nil		1,783		1,783		...	2,693	1,410	...	...
Province Wellesley ...	...	2,943	809	584	584	151	151	Nil		Nil		10,493		10,493		...	3,035	829	...	...
Penang ...	4,299	5,842	8	26	26	61	61	2,842	15,700	2,842	15,700		Nil		Nil	2,306	6,297	16	...	...
Singapore ...	7,911	26,762	202	179	179	24	24	14,155		14,155		17,599		17,599		6,386	33,525	256	25	25
Labuan ...	...	43	Nil	Nil	Nil	2	2	81		81		Nil		Nil		...	40	Nil	...	...
Total Straits Settlements ...	12,210	37,807	2,330	2,298	2,298	622	622	17,078	15,700	17,078	15,700	29,875	Nil	29,875	Nil	8,692	45,590	2,574	25	25
Total Malaya ...	12,210	53,850	24,488	27,078	27,078	12,946	12,946	17,078	15,731	17,078	15,731	47,986	15,906	47,986	15,906	8,692	62,325	27,140	43	43

TABLE II
DEALERS' STOCKS, IN DRY TONS 3

Class of Rubber	Federated Malay States	S'pore	Penang	Province We'sly D'dings M'cca.	Johore	Kedah
22	23	24	25	26	27	28
DRY RUBBER	10,757	32,295	6,029	5,415	2,930	221
WET RUBBER	1,135	1,230	268	371	617	237
TOTAL ...	11,892	33,525	6,297	5,786	3,547	458

TABLE III
FOREIGN EXPORTS

PORTS	For month	Jan. 1938
29	30	31
Singapore ...	29,578	29,578
Penang ...	14,774	14,774
Port Swettenham.	3,544	3,544
Malacca ...	90	90
MALAYA ...	47,986	47,986

TABLE IV
DOMESTIC EXPORTS 4

AREA	For month	Jan. 1938
32	33	34
Malay States ...	33,896	33,896
Straits Settlements	2,806	2,806
MALAYA ...	36,702	36,702

Notes :—

1. Stocks on estates of less than 100 acres and stocks in transit on rail, road or local steamer are not ascertained
2. The production of estates of less than 100 acres is estimated from the formula : Production + Imports + Stocks at beginning of month = Exports + Stocks at end of month. + Consumption, *i. e.*, Column [7] = Columns [13] + [14] + [17] + [18] + [19] + [20] − [2] − [3] − [4] − [5] − [9] − [10]. For the Straits Settlements the production of estates of less than 100 acres is represented by sales or exports as shown by cess paid.
3. Dealers' stocks in the Federated Malay States are reduced to dry weights by the following fixed ratios: unsmoked sheet, 15% wet sheet, 25% scrap, lump, etc., 40%; stocks elsewhere are in dry weights as reported by the dealers themselves.
4. Columns (33) and (34) represent exports of rubber subject to regulation which, for Singapore and Penang Islands are represented by sales or exports as shown by cess paid.
5. All statements are brought up to date monthly, and any inaccuracies that may be disclosed are corrected in the totals; the latest publication therefore, is always the most reliable.
6. The above, with certain omissions, is the Report published by the Registrar-General of Statistics, S.S and F.M.S., at Singapore on 25th February, 1938

METEOROLOGICAL SUMMARY, MALAYA, JANUARY, 1938.

Locality.	Air Temperature in degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine.		
	Means of			Absolute Extremes						Total.		Most in a day.	Number of days.					Total.	Daily Mean.	Per cent.
	A. Max.	B. Min.	Mean of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot	At 4 feet			Amt.	Precipitation .01 in or more	Precipitation, .04 in or more	Thunder-storm	Fog morning obs.	Gale force 8 or more			
	°F	°F	°F	°F	°F	°F	°F	°F	°F	in.	mm.	in.						hrs.	hrs.	
Railway Hill, Kuala Lumpur, Selangor ...	89.9	71.2	80.5	93	68	84	74	83.4	84.2	5.39	136.9	1.14	16	13	2	3		208.35	6.72	56
Bukit Jeram, Selangor ...	88.0	71.9	79.9	92	69	82	74	83.7	85.7	5.86	148.9	1.29	18	14	2	1		238.10	7.68	64
Sitiawan, Perak ...	88.6	72.4	80.5	92	68	82	74	83.7	84.1	6.79	172.5	2.43	17	15	2	2		226.05	7.29	62
Ipoh Aerodrome, Perak ...	90.6	71.0	80.8	95	67	81	74	83.2	83.8	2.91	74.0	1.05	10	9	1			231.60	7.47	63
Temerloh, Pahang ...	85.9	70.6	78.0	90	67	76	73	83.4	84.7	6.28	159.5	1.08	21	16	1	2		185.75	5.99	50
Kuala Lipis, Pahang ...	86.0	70.1	78.1	90	67	77	72	82.1	83.3	5.65	143.5	1.11	19	12		14		173.60	5.60	47
Kuala Pahang, Pahang ...	83.4	74.3	78.9	85	71	80	79	81.0	82.9	11.96	303.8	2.93	25	23			5	189.95	6.13	51
Kallang Aerodrome, S'pore ...	85.2	73.9	79.5	89	70	79	76	80.7	82.2	12.25	311.2	3.19	18	15		1	2	146.05	4.71	39
Bayan Lepas Aerodrome Penang ...	88.8	73.1	80.9	92	70	84	76	82.9	84.0	5.66	143.8	2.64	6	5				280.85	9.06	77
Bukit China, Malacca ...	87.2	72.8	80.0	92	70	81	74	81.7	83.1	3.85	97.8	1.34	14	11	1		3	211.05	6.81	57
Kluang, Johore ...	84.9	71.3	78.1	91	69	76	73	79.6	81.2	4.31	109.5	0.87	15	14	1	2	1	164.70	5.31	44
Bukit Lalang, Mersing, Johore	81.8	73.9	77.9	85	70	76	78	79.0	79.7	11.48	291.6	2.57	18	18	1		6	180.25	5.81	48
Alor Star, Kedah ...	89.1	70.3	79.7	92	67	84	75	82.0	84.1	1.18	30.0	1.12	3	2		1		290.35	9.37	79
Kota Bahru, Kelantan ...	84.8	71.6	78.2	87	67	81	76	80.6	82.5	3.84	97.5	0.64	18	17				235.40	7.59	64
Kuala Trengganu, Trengganu	82.5	72.7	78.1	86	69	79	77	79.7	81.2	3.66	93.0	1.10	18	15		3	1	205.70	6.63	56
HILL STATIONS.																				
Fraser's Hill, Pahang 4268 ft.	68.9	60.2	64.5	74	57	64	63	69.6	70.6	7.12	180.8	1.40	22	18		24	1	155.65	5.02	42
Cameron Highlands, Tanah Rata, Pahang 4750 ft. ...	71.2	56.4	63.8	74	49	67	63	69.3	69.9	2.46	62.5	1.16	14	10			2	182.95	5.90	49
Cameron Highlands, Rhododendron Hill, Pahang 5120 ft. ...	71.0	57.5	64.3	75	53	64	61			2.50	63.5	1.19	14	10			2	189.80	6.12	51

Compiled from Returns supplied by the Meteorological Branch, Malaya.